ON BRACHIONUS SERICUS, n. sp., A NEW VARIETY OF BRACHIONUS QUADRATUS, AND REMARKS ON BRACHIONUS RUBENS, OF EHRENBERG.

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Plates 11 and 12.

Brachionus sericus, n. sp.

Ever since 1895 I have been acquainted with a species of *Brachionus* which appeared to be new, but which I did not then describe as such owing to the confusion produced in my mind by the inaccuracies in the published figures of some of the old species. Having in the meantime seen and studied most of the known species of *Brachionus* and their varieties, I am able to add the above as a good new species to the Rotatorian fauna under the name of *Brachionus sericus*, Fig. 1, Pl. 11.

The specific characters may be stated as follows :

Lorica with six nearly equal, straight occipital teeth, with shallow median sinus ; mental edge ondulate, with rounded notch in the middle ; lorica rising posteriorly to form an overhanging border, which may be either simply rounded, or may extend to form a considerable pointed projection ; lorica covered all over with fine longitudinal wavy lines, giving the appearance of "watered silk."

My first acquaintance with this new species occurred in May, 1895, when I found it in one of the Totteridge ponds which we visited in the course of a Quekett excursion. Afterwards I obtained it sparingly in various places around London, particularly in Epping Forest, usually in small ponds full of decaying leaves, with clear brownish water ; and Mr. Scourfield sent it to me this spring from Snaresbrook. It has also been sent to me

from several places in the country, by Mr. John Hood from the neighbourhood of Dundee, and by Mr. John Stevens from Exeter.

In July, 1897, at the Club's excursion to Hertford Heath, I found a remarkable variety of this species, in which the dorsal plate extends posteriorly into a high and long projecting point, as represented in Figs. 2 and 3, Pl. 11.

In general appearance *B. sericus* resembles *B. urceolaris*, and no doubt has before now been mistaken for this species. On closer examination, however, it will be found that the structure of the lorica is very different. The whole of the lorica, including the ventral plate, is covered with very fine, regular, longitudinal wavy lines, which give it the appearance of "watered silk"; hence the name *sericus*. From certain points of view the basal plate has the appearance of being pitted, which Mr. Dixon-Nuttall (to whom I am once more indebted for the excellent figures on Pl. 11) has indicated in his drawing; but it seems to me that this appearance is due to the foreshortening of the wavy markings.

The high and rounded, or more or less pointed, dorso-posterior edge of the lorica overhangs the basal plate, forming here a recess in which the eggs are usually carried. Anteriorly the six teeth are nearly equal in length, the "antlers" being only slightly longer than the outer teeth, and the sinus between them is less deep than in *B. rubens* or *urceolaris*; the four inner teeth have each a short strengthening ridge. The mental edge is ondulate, with a rounded sinus in the middle. The foot opening is rounded or conical in shape in the ventral plate, and square in the basal plate on the upper side.

The greatest variation occurs in the dorso-posterior edge of the lorica, which, whilst always overhanging, may be simply rounded or prolonged into an obtuse point; or again, as in the Hertford Heath specimens, it may be extended into a very considerable pointed prolongation (Figs. 2 and 3), which gives these animals a

very different appearance from the type. As, however, intermediate forms occur, it seems unnecessary to make even a variety of these extreme forms.

The internal anatomy is quite normal, and follows that of *B. urceolaris*. The foot is long and wrinkled, except a short distal piece, which carries the two small conical toes.

The usual three kinds of eggs have been observed; the small male eggs and larger female eggs have the usual structure; the fertilised resting egg is broader at one end and has a thick shell which is deeply pitted, and the rounded contents inside only fills about half the cavity of the eggshell.

The male was obtained by isolating and hatching some male eggs; it has the usual characters of the *Brachionus* males, and its integument is but slightly chitinised; Fig. 4, Pl. 11, drawn by Mr. Dixon-Nuttall from a preserved specimen, gives a good idea of its appearance.

Size of lorica: female, length 292 μ ($\frac{1}{87}$ in.), width 231 μ ($\frac{1}{110}$ in.); size of male, 120 μ ($\frac{1}{210}$ in.): of resting egg 136 μ ($\frac{1}{185}$ in.); female egg 110 μ ($\frac{1}{230}$ in.).

Brachionus quadratus var. **rotundus**, n. var.

Since the discovery of *B. quadratus* in 1889, I have found this species in many localities around London, and often in considerable numbers in the Regent's Canal. It has also been sent to me from various parts of England, so that it is evidently a widely distributed species. Bilfinger has recorded it from Württemberg, and in 1905 I collected it in the Koorn Spruit, Orange River Colony, in South Africa.

Some two years ago Mr. John Wood sent me from Dundee a *Brachionus* which he could not name, but which I soon recognised by the peculiar lace-like structure of the lorica as a remarkable variety of *B. quadratus*, in which the sharp posterolateral corners of the type species have become rounded off, as

shown in Fig. 6. I have therefore named this *B. quadratus* var. *rotundus*. A second difference to be noted is that the median of the three spines guarding the foot opening is reduced to a rounded projection.

The drawing (Fig. 6) shows a series of fine longitudinal and transverse curved surface markings of the lorica; with the exception of the two median ridges these are really very faint, mere creases in the chitinous integument, and easily overlooked; they are, however, permanent and present also in the type species. The lace-like structure of the lorica is not shown, because it requires much greater magnification to render it visible.

The foot is long, stout at the base and tapering somewhat to the toes; it is transversely wrinkled and also shows the faint pseudo-jointed appearance characteristic of the type species. The small male eggs and larger female eggs are smooth and normal; the fertilised resting egg, however, is very peculiar, oval in shape, and covered all over with closely set stout cylindrical papillae as represented in Fig. 8. I had not seen the resting egg of *B. quadratus* when describing this species in 1889, but have found it since, and it is identical with the above, which is another link connecting the two animals.

The male (Fig. 7) was hatched from male eggs and corresponds in shape and structure to most other males of this genus, the chitinous integument being very thin and flexible.

The internal anatomy of *B. quadratus* var. *rotundus* is quite normal, and requires no further description. The size of lorica is 272 μ ($\frac{1}{93}$ in.), of resting egg 136 μ ($\frac{1}{185}$ in.), of female egg 122 μ ($\frac{1}{210}$ in.), of male egg 75 μ ($\frac{1}{340}$ in.).

Amongst the other known species there is one, namely, *Brachionus leydigii* of Cohn, which bears considerable resemblance to *B. quadratus* and the var. *rotundus*, and there can be no doubt that the three are closely allied and belong to the same group.

B. leydigii has a square-shaped lorica like *B. quadratus*, and a rounded median spine over the foot-opening like that of the var. *rotundus*, while the lace-like structure of the lorica and the papillose winter egg it has in common with both.

However, the strongly tessellated dorsal surface of *B. leydigii*, showing five rows of hexagons and pentagons, resembling in prominence the facets of *Anuraea serrulata*, is a character which is absent in the other two forms. Bilfinger mentions having observed among his *B. quadratus* one specimen with faceted lorica, resembling Cohn's figure; and the fact of the identical structure of the resting egg in all three forms is strong evidence in favour of their being closely allied species. The resting eggs in particular usually give the best characters to differentiate closely allied species of *Brachionus*, as Cohn himself has mentioned in his memoir of 1862.

It is quite possible, therefore, that these three forms may eventually be found to be varieties of one species, in which case *B. leydigii* would be the type species and the other two varieties. However, before making such changes I should like to have the opportunity of examining some faceted specimens corresponding to Cohn's figure. My present object is merely to record the rounded variety of this group of *Brachionus*.

Brachionus rubens, Ehrenberg.

It is unfortunate that in Hudson and Gosse's monograph *B. rubens* is wrongly figured, a fact which has caused considerable confusion and difficulty in separating this species from *Br. urceolaris*. A glance at Ehrenberg's figures of *B. rubens* published in 1838 will show that the frontal teeth of the lorica have a peculiar unsymmetric shape, each tooth showing a narrow anterior part, and then slanting outwards and forming a broad base (best understood by referring to Fig. 9), quite unlike those shown in

Mr. Gosse's figures, which really represent slight varieties of *B. urceolaris*.

The lorica of both species is smooth, glassy transparent, rounded dorsally, and of about the same size. Anatomically, also, the two species can hardly be separated, and the foot-opening in both is rounded in the ventral plate and square dorsally.

The shape of the frontal teeth of the lorica therefore is the main distinguishing mark; but in addition *B. rubens* has a unique habit, mentioned by Ehrenberg as having been observed already by Schäffer in 1755, of attaching itself by its toes to water-fleas, sometimes covering the whole surface of the shell of this crustacean, and thus causing poor *Daphnia* considerable impediment and discomfort. The *Brachioni* readily detach themselves when so disposed, swim about in the water for a while and fix themselves again on the back of the next water-flea they come across. They appear quite at home there, lay numerous eggs, and breed freely. In ponds where *Daphnia* is not numerous every one of them has its load of *B. rubens* when present. If the *Daphnia* be killed, all the *Brachioni* speedily abandon the dead host. One can imagine a *Daphnia's* delight when, in moulting, which may occur once in three or four days, it can slip out of its "old clothes" and suddenly escape from its unbidden guests. It is hardly a case of symbiosis, for the advantages are all on one side.

An interesting biological problem is presented by the fact that *B. rubens* has learned to make systematic use of *Daphnia pulex* as a means of easy locomotion, whilst the closely allied species *B. urceolaris*, living in identical surroundings, has not yet acquired this useful habit. It seems clear that there must exist a corresponding difference in the intellect or in the quality of the brain of these two species which has enabled the one to discover and make use of a means of locomotion which the other has not yet thought of, and seems incapable even of imitating. The

exploitation of the obvious advantage of riding, free of charge and without exertion, on a *Daphnia's* back appears to show a higher education and greater intelligence in *B. rubens* (or perhaps a lower type of morality as suggested by Mr. Scourfield) than in *B. urceolaris.* Various free-swimming *Rotifers* occasionally and temporarily attach themselves to water-fleas; but I know of only one species other than *B. rubens* that does so systematically, namely, *Proales daphnicola*, Thompson.

Brachionus rubens is not a very common species. I have found it occasionally around London, particularly in a pond at Totteridge, and have had it sent to me from Kent and other parts in the country, always associated with *Daphnia.*

Both Dr. Hudson and Mr. Gosse appear never to have become acquainted witht he true *B. rubens.* I once showed Dr. Hudson some mounted specimens and pointed out their agreement with Ehrenberg's drawings, and their disagreement from Mr. Gosse's figures. His reply was that the only explanation he could give was that the published figures had been selected by Mr. Gosse from numerous sketches in his possession as the ones coming nearest to those of Ehrenberg; he quite agreed that Ehrenberg was correct and that his figures of *B. rubens* ought to be taken as representing the true species.

From what has been said it follows that in Hudson and Gosse's monograph, fig. 5, pl. xxvii., and also the figures of Plate A, must be taken to represent *B. urceolaris* and not *B. rubens.*

Fig. 9 of Pl. 12 has been very carefully drawn to show the usual shape of the frontal teeth of the true *Brachionus rubens*, but these teeth are subject to individual variation. Fig. 10 is a drawing from a photograph by Mr. W. Imboden of a mounted specimen under dark-ground illumination, whilst Fig. 11 represents the male drawn by Mr. F. R. Dixon-Nuttall. The resting egg is of a light brown colour, elongate, broad at one end and obtusely pointed at the other, enclosing a nearly spherical

embryo; the stout eggshell is finely granular and pitted with shallow depressions.

The measurements of this species show the following dimensions: lorica, 279 μ ($\frac{1}{91}$ in.); male, fully extended, 136 μ ($\frac{1}{185}$ in.); female egg, 122 μ ($\frac{1}{210}$ in.); male egg, 85 μ ($\frac{1}{300}$ in.); resting egg, 163 μ ($\frac{1}{155}$ in.).

Explanation of Plates.

Plate 11.

Fig. 1. *Brachionus sericus*, normal type, side view, × 160.
„ 2. „ „ variety with pointed posterior prolongation, dorsal view, × 160.
„ 3. „ „ variety with pointed posterior prolongation, side view, × 160.
„ 4. „ „ male, × 390.
„ 5. „ „ resting egg, × 200.

Plate 12.

Fig. 6. *Brachionus quadratus*, var. *rotundus*, × 180.
„ 7. „ „ „ „ male, × 375.
„ 8. „ „ „ „ resting egg, × 240.
„ 9. *Brachionus rubens*, Ehrenbg., outline of lorica, × 200.
„ 10. „ „ „ photo, × 136.
„ 11. „ „ „ male, × 370.